Short Wave Therapy Unit

ULTRATHERM 908i

Service Manual

© gbo Medizintechnik AG 2004

The gbo Medizintechnik AG has taken care in preparation of this service manual, but makes no expressed or implied warranty of any kind and assume no responsibility for errors or omissions.

All rights reserved. No part of this service manual may be reproduced, in any form or by any means (electronic, mechanical, or otherwise) without the prior written permission of the gbo Medizintechnik AG.

© gbo Medizintechnik AG 2004

gbo Medizintechnik AG
Kleiststr. 6

D-64668 Rimbach
Germany

Tel. 0 62 53 / 808-0
FAX 0 62 53 / 808-300

Contents

CONTENTS 3

OVERVIEW 6

1. GENERAL INFORMATION 7

1.1. Purpose 7

1.2. Short User Manual 8
1.2.1. Operation Unit 8
1.2.2. Operation Direction 9

2. TECHNICAL DATA 10

3. ELECTRICAL AND FUNCTIONAL DESCRIPTIONS 11

3.1. Description of the subassemblies 11
3.1.1. Power supply - subassembly A100 11
3.1.2. Power generator - subassembly A200 11
3.1.3. Harmonic filter - subassembly A500 11
3.1.4. Output circuit - subassembly A300 12
3.1.5. Control computer - subassembly A400 12

3.2. Description of the Overall Wiring Diagram 14

4. TEST 15

4.1. Safety instructions 15

4.2. Testing devices and measuring instruments 15

4.3. Pretest 16
4.3.1. Check of earthing connections 16
4.3.2. Check of the fuse elements 16

4.4. Operation test 16
4.4.1. Stand by operation 16
4.4.2. Modes of operation 17
4.4.2.1. „MODE“ and „APPLICATOR“ keys 17
4.4.2.2. „+“ and „-“ keys, „MINUTES“ indicator 17
4.4.2.3. Power selector „INTENSITY“, indicators „WATTS“ and „TUNING“ 17
4.4.2.4. Emergency-off function 18
4.4.2.5. RESET key 18

4.5. Tuning 18

4.6. Check of the operating voltages and currents 19

© gbo Medizintechnik AG 2004

4.7. Check of generator frequency and pulse parameters 20
4.7.1. Generator frequency 20
4.7.2. Pulsed operation of „70 Hz“ 20
4.7.3. Pulsed operation of „350 Hz“ 20

4.8. Check of the power output 20
4.8.1. Coil applicator 20
4.8.2. Capacitor-field applicator 21
4.8.3. Auxiliary check of the power output 21

4.9. Check of the internal error recognition circuits 22
4.9.1. Temperature monitoring circuit 22
4.9.3. Generator voltage 22

4.10. Continuous operation 22
4.10.1. Preparation for continuous operation 22
4.10.2. Performance of the continuous operation 22

4.11. Final test 23
4.11.1. High-voltage test 23
4.11.2. Measurement of the leakage current of the casing 23
4.11.3. Earthing conductor test 23
4.11.4. Measurement of the mains current consumption 24
4.11.5. Check of the power values 24
4.11.6. Operation check 24

5. SERVICE INSTRUCTIONS 25

5.1. Function check of the power generator A200 25
5.1.1. Check of the supply voltages 25
5.1.2. Readiness for operation of the A200 subassembly 25
5.1.3. General information on the power loop 26
5.1.3.1. Level control 26
5.1.3.2. Amplification tract 26
5.1.3.3. Power and mismatching meter LFM 27
5.1.3.4. Adding amplifier 27
5.1.3.5. Subtracting amplifier 28
5.1.3.6. Multiplier (N202) 28
5.1.3.7. Setpoint/actual value comparator 28
5.1.3.8. Cable voltage monitoring circuit 29
5.1.3.9. Analogous OR interconnection 29
5.1.4. Operation of the power supply 29
5.1.5. Oscillator 30
5.1.6. Driver 30
5.1.7. RF circuits at the final stage output 30
5.1.8. Typical measurement values with a matched load (50 ohm) 30

5.2. Repair instructions for the control computer (A400) 31
5.2.1. Indication of the error conditions 31
5.2.2. Description of the control computer signals 32

5.3. Power supply (A100) 33

5.4. Output circuit (A300) 33

5.5. Harmonic filter (A500) 33

© gbo Medizintechnik AG 2004

6. DISASSEMBLY/ASSEMBLY FLOW CHART 34

7. ORDERING INFORMATION 35

8. PARTS LIST 37

9. WIRING DIAGRAMMS 38

CORRECTION SHEET 39

© gbo Medizintechnik AG 2004

Overview

Chapter 1 describes the basic purpose of the **ULTRATHERM® 908i.**

Chapter 2 gives technical data of the unit.

Chapter 3 explains the functions of the subassemblys and the overall wiring diagramm.

Chapter 4 give some safety instructions during the service and describes the test of the whole unit.

Chapter 5 includes the service instructions and informs about the trobleshooting.

Chapter 6 explains single steps to exchange a part.

Chapter 7 gives ordering information.

Chapter 8 gives a list of parts.

Chapter 9 contains the pictures and the wiring diagramms of the unit.

© gbo Medizintechnik AG 2004

1. General Information

1.1. Purpose

The **ULTRATHERM 908i** is a high performance short wave therapy unit for high frequencey heat therapy that operates at the well proved frequency of 27,12 Mhz (wave lengh 11 m). It enables the classical therapy in capacitor-field and electromagnetic coil fields in both the continuous and the pulsed mode of opararion and, therfore, it is suited for all heat therapy treatments in clinic as well as practice.

The use of high frequency energy for the heat therapy has the advantage of larger penetration depth in contrast to the conventional methods, such as hotpacks, baths, infrared light, heat pillows, and even to the mirowave.

The heat endogenically generated by this therapy unit induces a whole range of physiological processes which, for example, spasmodically influence the muscular system, tendons and other connective tissue structures, increase the cell metabolism, rate of enzyme reaction and improve the blood circulation in the area under treatment.

As the high frequency energy can be applied in short but high energy shocks (pulsed mode) the penetration depth can be increased futher, particularly the positive effect on the blood circulation, while the thermosensitive skin hardly feels the heat.

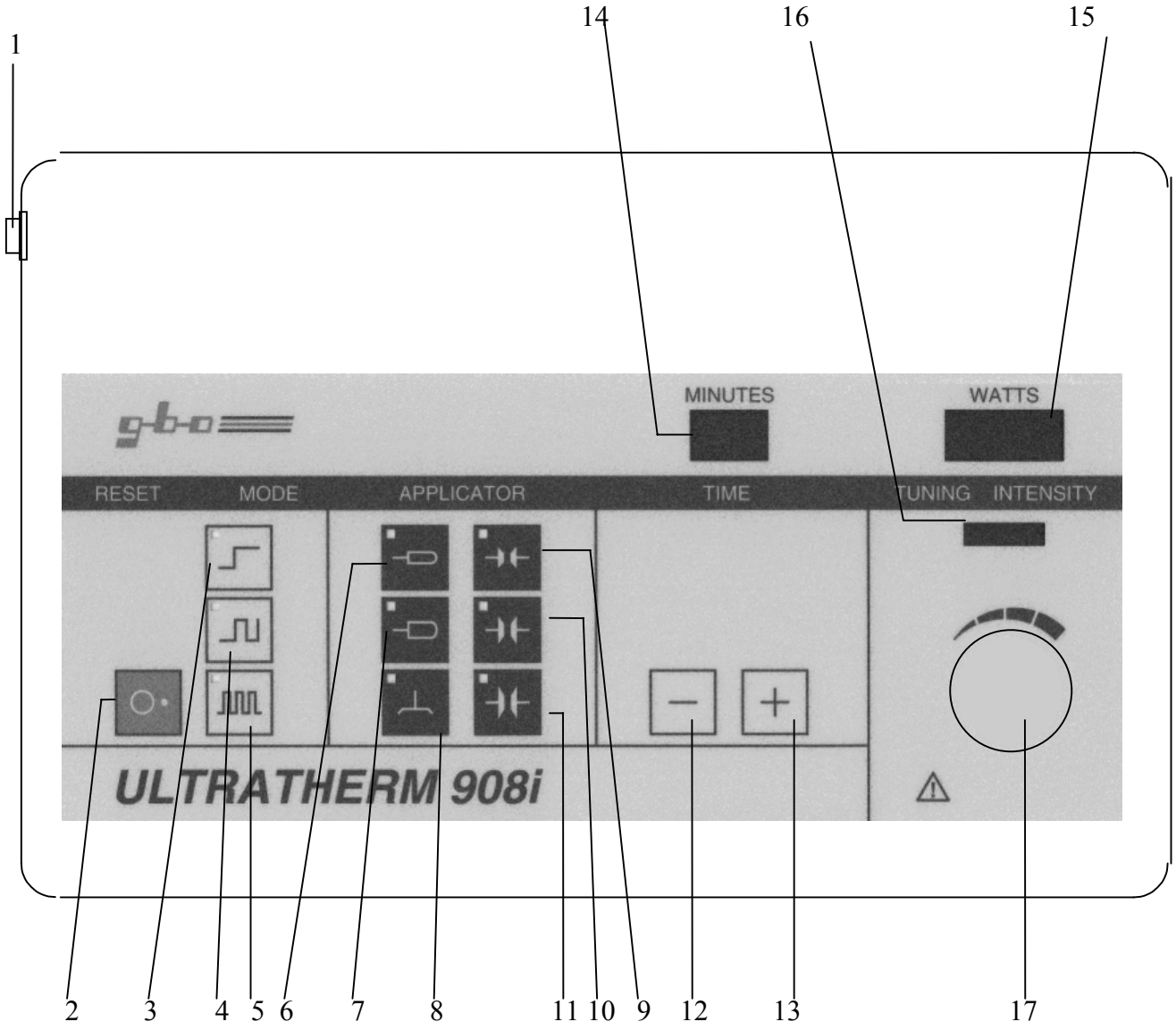
High frequency heat therapy can by applied in a wide field. It is particularly suited for all rheumatic ailments of the joints and muscular system, inflammatory ailmants of respiratory organs, kidnesy and urinary tracts and all ailments caused by blood circulation.

For acute conditions the pulsed mode of operation offers advantages.

© gbo Medizintechnik AG 2004

1.2. Short User Manual

1.2.1. Operation Unit



1 Power switch with light indicator

2 RESET key

3 Key „Continuous mode of operation“ with LED.

4 Key „Pulsed mode of operation“ 70 Hz/2 ms with LED

5 Key „Pulsed mode of operation“ 350 Hz/0.4 ms with LED

6 Key „Coil applicator“ MINODE ∅ 8 cm

7 Key „Coil applicator“ MONODE ∅ 14 cm

© gbo Medizintechnik AG 2004

8 Key „Coil applicator“ DIPLODE 18 x 39 cm

9 Key „Capacitor-field applicator“ ∅ 4.2 cm and
„Capacitor-field applicator“, elastic 8 x 12 cm

10 Key „Capacitor-field applicator“ ∅ 8.5 cm
„Capacitor-field applicator“, elastic 12 x 18 cm

11 Key „Capacitor-field applicator“ ∅ 13 cm
„Capacitor-field applicator“, elastic 15 x 25 cm

12 Key „Decrease treatment time“

13 Key „Increase treatment time“

14 Display „treatment time“ in minutes

15 Display „Dosage“

16 Display „Coupling with patient“

17 Dosage knop

1.2.2. Operation Direction

- Connect the therapy unit to the mains socket outlet
- Connect the applicator(s) to the therapy unit
- Attach the applicator(s) to the patient
- Turn on the therapy unit with switch (1)
- Select the mode of operation, buttons (3), (4), (5)
- Select the mode of the applicator(s), buttens (6) to (11)
- Set the treatment time, button (12), (13)
- Set the dosage, knob (17)
- Electric power is applied to the output, the treatment timer starts operation
- After the chosen treatment time has elapsed, the therapy unit automatically turns off and emits an intermittent acoustic signal for about 10 s. This signal is repeated every minute until the dosage knob (17) is reset by turning to the left (counterclockwise).
- When an error is displayed (except for FE 0) press RESET button (2) and readjust if required.
- The entire therapy unit is switched off by actuating swich (1) again.

For more imformation please look in the User Manual of the **ULTRATHERM 908i**.

© gbo Medizintechnik AG 2004

2. Technical data

Mains Voltage On request	230 V a.c. ± 15% 50/60 Hz 115 V a.c. ± 15 %; 50/60 Hz
Electric fuses (external)	10 A slow acting for 230 V 16 A slow acting for 115 V
Protective system	Class I
Power consumption maximum Stand-by oparation	about 700 VA about 100 VA
Frequency	27,12 MHz ± 0,6 %
RF output power at 50Ω continuous mode Pulsed mode	 200 W 30 W
Power equivalent	400 W
Pulse parameters Peak pulse power Pulse repetition fequency Pulse width	 400 W 70 Hz/350 Hz 2 ms/0,4 ms
Dimensions	85 x 38 x 39 cm³ (HxWxD)
Weight	45 kg
Safety test	DIN VDE 0750 Part 1 DIN VDE 0750 Part 204 DIN VDE 0871 MedGV - group 3

© gbo Medizintechnik AG 2004

3. Electrical and functional descriptions

3.1. Description of the subassemblies

3.1.1. Power supply - subassembly A100

The A100 subassembly is a mains-frequency clocked switching power supply generating the V1 (+5 V), V2 (+15 V) and V3 (-15 V) supply voltages. The outputs SK4 to SK6 are connected in parallel to each other. Through plug connector SK7 (terminals 1 and 3) the mains power is fed in; this connector is designed for 230 V as well as 115 V. The jumper „Link for 115 V operation“ is to be plugged in accordance with the available mains voltage. The fine adjustment of the V2 supply voltage is to be performed by means of control P1. When exchanging this subassembly it is to be observed that the Y capacitors C16/C17 are not provided and that an electrically safe connection between earthing conductor and base plate is to be ensured.

3.1.2. Power generator - subassembly A200

This module can be subdivided into three main sections. The first one includes the crystal-controlled generation, amplification and filtration of the 27.12 Mhz high-frequency power. The second one of this subassembly includes the measurement and control circuits which enable an exact adjustment of the output power. And the third section contains the control circuit of the operating voltage of the amplifier.

Any repair work of this subassembly shall only be performed by the manufacturer. That’s why, this description is restricted mainly to the terminals. The supply power of the subassembly is fed via the plug connectors X206 (+15 V), X209 (-15 V) and X210 (earth). Additional supply terminals are X201 to X205 which are used for the regulation of the operating voltage of the output amplifier. There importance as well as that of the terminals X207, X208, X211 to X213 is described in detail in clause 3.2. The power is coupled out at the coaxial connector X222. This A200 subassembly is delivered in the tested and tuned condition. Only the fine adjustment of the output power is to be performed by means of R202.

3.1.3. Harmonic filter - subassembly A500

A harmonic filter, that additionally attenuates the RF interference spectrum in the frequency range between 54 Mhz and 100 Mhz, is directly connected to the RF output of the power generator. It’s adjustment is necessary to ensure being below the interference levels given by law. In case of erroneous operation this subassembly has to be replaced in any case. Avoid any dismounting of the air-core chokes L501/L502. The cover on this subassembly is absolutely necessary to maintain the low RF interference values required by law.

© gbo Medizintechnik AG 2004

3.1.4. Output circuit - subassembly A300

The output circuit is provided to match the application part, which is connected to the balanced output X004/X005, as exactly as possible to the generator. The matching is performed by means of the adjustable capacitor C302 driven by stepping motor M301, which is a component of a serial circuit in connection with the coils L302 and L303. The RF power is fed through connection X301. The RF power flows via the capacitor chain C303 to C305 to the balance-to-unbalance transformer L301/L302/L303 whose secondary windings are parts of the serial circuit mentioned above.
The stepping motor is triggered by control computer A400. 4 additional diodes protect the stepping motor (they are not drawn in the wiring diagramm).
All other parts, given in the layout, are not required.

3.1.5. Control computer - subassembly A400

Subassembly A400 is the central unit which realizes all signal and operation functions as well as measurement and control operations. The micro-controller 87C196KB, which reduces the computer hardware to a minimum and, thus, is a very service-friendly solution, is the basis of this control computer.

The integrated circuit 87C196KB contains clock generator, CPU, program memory, A/D converter, counter/timer and several different input and output ports. For clock generation (8 Mhz) only the external components Q401, C406 and C406 are to be connected. After switchingon the watch-dog circuit D401 generates a reset signal and initiates a defined start of the internal program. But the generation of the reset signal is also possible by means of key S409. The supply voltages +5 V, +15 V and -15 V are applied to the subassembly via X403. Mode of operation, applicator type and treatment time are adjusted by means of the key matrix S401 to S408 and S410 to S412. They are triggered by the output ports P1.4 to P1.7 and evaluated by the input ports P2.1 to P2.3 which are loaded by the pull-up resistors R449 to R451. The output power is adjusted by means of pulse generator D408, feeding the two direction-of-rotation dependent signals (2) and (4) to the prosessor via NMI and P0.5. Processor output P2.5/PWM delivers a pulse-duration modulated signal that is converted to a DC voltage by the two operational amplifier networks N401A/N401B and used to control the power output of generator A200. The connection C402 to D402 (P0.6) is used to monitor the D/A conversion. In the pulsed modes of operation the DC voltage is keyed via processor output pin P4.7/AD15 and transistor T401. The generator control voltage, the level of which is also monitored by processor (P0.6), applies at plug connector X401.5. The bar indicator VD401 consists of ten LEDs and signals the degree of matching between patient circuit and generator output. The individual LEDs VD402 to VD410 have the following meaning:

VD402 signals the adjustment of the „**DIPLODE**“ applicator.

VD403 signals the adjustment of the Medium coil-field „**MONODE**“ applicator.

VD404 signals the adjustment of the Small coil-field „**MINODE**“ applicator.

VD405 signals the adjustment of the „Large capacitor-field electrode“ applicator.

VD406 signals the adjustment of the „Medium capacitor-field electrode“ applicator.

VD407 signals the adjustment of the „Small capacitor-field electrode“ applicator.

VD408 signals the adjustment of the „350 Hz“ pulsed mode of operation.

VD409 signals the adjustment of the „70 Hz“ pulsed mode of operation.

VD410 signals the adjustment of the „continuous-wave“ (CW) mode of operation

The above information applies in multiplexed form at the processor output pins P3.0/AD0 to P3.7/AD7 and is stored by the integrated circuits D404 to D406. This includes also the triggering of the piezo-signal transmitter B401. Signal D406(Q5) and D406(Q6) is not used. The 7-segment indicators VD411 to VD415 are also triggered in the multiplexed mode of operation. Data sources are the processor output pins P4.0/AD8 to P4.3/AD11, the hexadecimal data of which are decoded by integrated circuit D407. Amplified by T402 to T406 the multiplexed signals P2.0/TXT and P1.0 to P1.3 are fed to the anodes of the indicator elements and show the following information:

VD411 shows the ten’s place of the minutes of treatment time.

VD412 shows the one’s place of the minutes of treatment time.

VD413 shows the hundred’s place of the unit’s output power.

VD414 shows the ten’s place of the unit’s output power.

VD415 shows the one’s place of the unit’s output power.

Integrated circuit D403 is used as driver circuit. In addition to the above signal it amplifies the motor control signals (M301) which are generated at D402 (P2.6 and P2.7). Both signals are directly amplified, inverted and transmitted to the plug connector X402 (pins 1 to 4). At each of it’s outputs, D403 has a free-wheeling diode and the other-end connectors „D“ of which are connected to the +15 V supply voltage.

The switch condition of the emergency-off switch connected at plug connector X403.6 is evaluated by transistor T408 and terminal D402 (P2.4/T2RST) of the processor which signals this information for further processing. An emergency-off actuation additionally releases a switching operation of the transistors T409 and T407 where the collector of the last actuates the power relay K001 via X403.5.

Micro-controller 87C196KB has eight analogous inputs (P0.0 to P0.7). The directional coupler signals U_S+U_D and U_S-U_D, whose amounts are used for tuning the output circuit by means of M301, are connected to P0.0 and P0.1. At X401.3 there applies a signal that is proportional to the

© gbo Medizintechnik AG 2004

output power. Via the resistor network R465/R466 this arrives at pin P0.2 of the processor. R465 is provided for tuning the output power of the unit.
This circuit realizes two additional monitoring functions. A thermistor (R003) is provided at the heat sink of subassembly A200 for checking the temperature of this subassembly. It is connected to X401.4. R439 is a component of a voltage divider whose output value is measured at pin P0.3. The voltage across the power stage of subassembly A200 is monitored through the voltage divider R440/R441 whose feeding point is connected to X401.8.
The diodes V401 to V405 and capacitors C407 to C425 meet protective and RF interference protection functions.

3.2. Description of the Overall Wiring Diagram

The power supply of the **ULTRATHERM 908i** is realized by the mains transformer T001 and the A100 subassembly that is connected with the 115 V or 230 V, 50 Hz/60 Hz, mains via mains input A001, RF interference protection filter A002 and mains switch S001. The unit is adjusted to the corresponding mains voltage by the manufacturer. The 45 V output voltage of T001 is required for generating the supply voltage of the power stage of subassembly A200. The voltage is rectified by bridge G001 the positive pole of which is connected to X205. In the other DC path there is arranged thyristor V001 which is triggered by the operating voltage control circuit of subassembly A200 and charges capacitor C001 in dependence on the generator output power. This is synchronuously performed to the mains frequency, where the 26 V voltage of T001 between X205 and X203 is used. The regulated DC voltage between X205 and X201 is superimposed by a serrated AC voltage of different amplitude and frequency.

C001 is discharged via the R002 resistor. The supply voltage of the control circuit applies between X204 and X205.

The two DC voltages of +15 V (X206) and -15 V (X209), with their reference point X210, are required for the analogous circuits of subassembly A200 and preamplifier. They are prepared in the power supply module A100 (SK6.3 and SK6.4). The relay contact K001.1 which interrupts the supply of the preamplifier under emergency-off condition is connected in series with the positive signal path. The DC fan motor M001 is supplied with the negative voltage after a voltage reduction by diode V002. Capacitors and Filters C002 to C019 are applied for certain measures of the RF interference suppression.

A400 is fed via plug connector SK5 of subassembly A100. At SK4.1 the emergency-off switch is connected to +5 V and the power relay K001 to -15 V (SK4.4). When the -15 V circuit is interrupted, the contact opens and switches off the power of generator A200. The plug connectors SK4 to SK6 are connected electrically in parallel and their common reference point „COM“ lies on the casing potential.

The remaining part of the circuit was already described in the above description of the sub-assembly. Finally, it is to be mentioned, that with any service work particularly care is to be taken to the earthing connections given in the wiring diagram because they are decisive for maintaining the low RF interference suppression level.

© gbo Medizintechnik AG 2004

4. Test

4.1. Safety instructions

Since the wiring, transformers, and switching assemblies, contained in this unit, are connected to line voltages, the measurement and setting procedures, required for troubleshooting and adjustment, must be performed with the utmost care.

Do not touch any connected measuring instruments or metal parts of the load test object while the unit is switched on. **Risk of burns!**

Persons who are in the area surrounding the cables or applicators working, have to deposit all metal objects such as watches, jewelry, keys, metal-rimmed eyeglasses, hearing aids, electronic equipment, etc.

4.2. Testing devices and measuring instruments

- High-voltage measuring instrument (6 kV)
- High-voltage testing equipment
- Leakage current measuring device
- Earthing-conductor testing device (20 A)
- Insulation resistance measuring instrument
- Test aerial
- Power meter
- Probe
- Precision resistor 50 Ω (cf. Spare parts list)
- Line-voltage regulator (230 V)
- Adjustable isolating transformer
- Digital multimeter
- Moving-iron instrument (0.5 A,10 A)
- Oscilloscope (50 Mhz)
- Frequency meter (50 Mhz)
- Resistance phantom circuit
- Lamp phantom
- Thermometer (50 °C)
- Diverse measuring lines and coaxial transitions

© gbo Medizintechnik AG 2004

4.3. Pretest

- Remove the face of the unit.
- Remove the cover of the RF subassembly.

4.3.1. Check of earthing connections

- Visual inspection of the X001 connections to the unit's rear wall and control desk.
- Visual inspection of screw connections at the base and RF subassemblies.

4.3.2. Check of the fuse elements

- F001/F002 (combined element A001) - according to the voltage version:
  230 V version: SP 6.3 A, fast (ceramic pipe, dim. 5 mm x 20 mm)
  115 V version: FST 6.26 A, slow (glass pipe, dim. 6.3 mm x 32 mm).
- F003 (mains transformer T001) - FST 50 mA, slow (glass pipe, dim. 5 mm x 20 mm).
- F1 (power supply A100) - FST 1.6 A, slow (glass pipe, dim. 6.3 mm x 32 mm).

4.4. Operation test

- Set mains switch S001 to position „0".
- Connect the unit to the line-voltage regulator switched to the rated mains voltage.
- Mains-voltage indicator in S001 shall not be lit.

4.4.1. Stand by operation

- Switch on the unit by means of S001.
- Mains-voltage indicator in S001 shall be lit green (only with the 230 V version).
- Treatment time „MINUTES" (VD411/412) indicates „0".
- Power indicator „WATTS" (VD413 to 415) indicates „0".
- All other indicators are inactive.

© gbo Medizintechnik AG 2004

4.4.2. Modes of operation

4.4.2.1. „MODE“ and „APPLICATOR“ keys

- Pressing one of the 9 keys (S402 to 404, 406 to 408, 410 to 412) activates the assigned LED.

4.4.2.2. „+“ and „-“ keys, „MINUTES“ indicator

- A short actuation of the „+“ key (S405) increments the treatment time indicator „MINUTES“ by 1 (end value 30).
- Continuous actuation of the „+“ key increases the indicated time in steps of 5 digits (e. g. 5, 10, 15, etc. - end value 30).
- The actuation of the „-“ key (S401) has the similar effect but the time indicated is reset (end value 0).
- Simultaneous actuation of both keys results in the indication of „0“

4.4.2.3. Power selector „INTENSITY“, indicators „WATTS“ and „TUNING“

- Separate the coaxial plug connection X222 and connect the generator output to the test aerial or 50 Ω precision resistor, respectively.
- Check the indication of the power ranges:

3 W	to 30 W	in	3	W steps
30 W	to 80 W	in	5	W steps
80 W	to 200 W	in	10	W steps

  as well as the power range limits in dependence on the mode of operation and the applicator selected in the following way.
- Select „CW“ mode, „**DIPLODE**“ applicator and treatment time (> 0);
- Turn the power selector (D408) by one click-stop detent to the right side;
- „A“ must appear on the „MINUTES“ indicator for Tuning;
- After switching over the indicator to treatment time the power of „9 W“ must be displayed, and all LEDs of the bar indicator (VD401) are activated;
- Check the power ranges by additional incrementing the power selector to the right;
- Then set the power to „0“ by turning the power selector to the left side;
- Repeat this prosedure in the CW mode of operation for all applicators where the initial values after the tuning operation (9 W each) as well as the end values are to be checked:

coil-field electrode, small	30 W
coil-field electrode, medium	90 W
capacitor-field electrode, small	21 W

© gbo Medizintechnik AG 2004

capacitor-field electrode, medium	80 W
capacitor-field electrode, larg	200 W

- Subsequently check the limit values of the power ranges in the pulsed modes (initial values 3 W each), the end values are 30 W for all applicators except the small capacitor-field electrode with 21 W.

4.4.2.4. Emergency-off function

- Set the output power to any value > 0.
- Wait for the duration of tuning process.
- Actuate the emergency-off switch.
- A continuous acoustic signal must sound and all optical indications must be exstinguished.
- Relay K001 must be released.
- Then turn the power selector to the left.
- The acoustic signal terminates and the unit changes to the stand by mode.
- Relay K001 must be active.

4.4.2.5. RESET key

- Adjust any treatment time value.
- Press RESET key (S409).
- After this, the unit must be in the stand by mode.

4.5. Tuning

- Set the unit to the stand by mode.
- Engage the coaxial plug connection X222.
- Connect the test aerial to the unit output X004/X005.
  (By way of substitution, the output power can be determined by means of the precision resistor of 50 Ω and a multimeter. In such a case the following three steps can be neglected).
  Calibration of the thermal probe with the power meter.
- Set the following parameters on the power meter:
  „dB REL“ = 39.70 dB,
  „LINEARITY FACTOR“ according to the value on the probe label,
  „CAL FACTOR“ = 1,
  „RANGE“ = 0,
  „AVERAGE“ = 7,
  „DUTY CYCLE“ = 100 %.
- Connect the power meter to the (-40)-dB output of the test aerial.

© gbo Medizintechnik AG 2004

- Connect the digital multimeter between the X206 and X210 terminals.
- Adjust the operating voltage „+15 V“ to 15.00 V ..15.05 V by means of P1 (A100).
- Set the unit to be tested to the following values:
  „CW“ mode of operation,
  „**DIPLODE**“ applicator,
  Treatment time „30“,
  Power „9“.
- After the automatic tuning run adjust the output power to 9 W ±0.3 W by means of R465.
- Set the power at the unit to be tested to „150“.
- Adjust the output power to 150 W ±2 W by means of R202.
- Set the power selector to „0“.

4.6. Check of the operating voltages and currents

- Set the mains power supply to rated mains voltage (constant).
- The measurement of the mains current consumption is performed by means of the moving-iron instrument.
- With a load resistance of 50 Ω at X004/X005, the operating voltages and currents are to be measured in the stand by mode (1) and for the output power of 200 W according to the following table:

Test		**Setpoint (1)**	**Setpoint (2)**
Operating voltages between: (+) pole	(-) pole	in V	in V
SK5.1	earth	+5 ±0.15	+5 ±0.15
SK5.3	earth	+15 ±0.1	+15 ±0.22
SK5.4	earth	-14.5 ±0.5	-5 ±0.22
X205	earth	+12 ±2	+45 ±2
Mains current consumption:		in A	in A
at 230 Va.c./50 Hz		max. about 0.5 A	max. about 3.0 A
at 115 Va.c./50 Hz		max. about 1.0 A	max. about 5.8 A

© gbo Medizintechnik AG 2004

4.7. Check of generator frequency and pulse parameters

4.7.1. Generator frequency

- Connect the test aerial to output X004 and X005.
- Connect the frequency meter to the (-40)-dB measurement output of the test aerial.
- Set the „**DIPLODE**“ applicator, „CW“ mode and treatment time.
- Adjust the power, wait for the tuning run.
- Determine the transmitter frequency ($f_{setpoint}$ = 27.11 Mhz to 27.13 Mhz).
- Turn the power selector to „0“.
- By way of substitution and with the above adjustments, the generator frequency can be measured with a capacitor of 1 pF/400 V connected in series to socket X004/X005 in the no-load operation.

4.7.2. Pulsed operation of „70 Hz“

- Connect the oscilloscope to the (-40)-dB measurement output of the test aerial.
- Select the „70 Hz“ pulsed mode and the treatment time.
- Select the output power and wait for the tuning run.
- Measure the pulse duration ($t_{p/setpoint}$ = 1.8 ms to 2.2 ms) and frequency ($f_{setpoint}$ = 65 Hz to 75 Hz) by means of the oscilloscope.
- Set the power selector to „0“.
- The pulse duration can also be determined by means of the oscilloscope at the precision resistor of 50 Ω.

4.7.3. Pulsed operation of „350 Hz“

- Select the „350 Hz“ pulsed mode and proceed according to clause 4.7.2.
- Measure the pulse duration ($t_{p/setpoint}$ = 350 µs to 450 µs) and frequency ($f_{setpoint}$ = 325 Hz to 375 Hz) by means of the oscillossope.
- Set the power selector to „0“.

4.8. Check of the power output

4.8.1. Coil applicator

- Connect the test aerial including the thermal power meter to X004/X005.
- Instead of test aerial and thermal power meter the precision resistor of 50 Ω, multimeter and oscilloscope can be used. However, with the pulsed modes now the power can only be

© gbo Medizintechnik AG 2004

measured by means of the oscilloscope. The measurement has to be performed without any earthing connection which, otherwise, would negatively influence the measurement results. The output power is to be calculated from the measurement values of pulse amplitude (U_m), pulse duration (t_p) and pulse period (T) in the following way:

for CW operation: the value P_{CW} [W] corresponds to that of U_m^2 [V]

for pulsed operation: the value of P_p [W] corresponds to that of U_m^2 [V] multiplied by the factor t_p/T .

- Set the „**DIPLODE**“ applicator and treatment time.
- In the different modes of operation the following power values are to be checked, where at least 9 LEDs of the bar indicator must be lit after the tuning:

Made of operation	**Min. power range [W]**	**Max. power range [W]**
CW mode	9 ±0.5	200 ±20
Pulsed mode 70 Hz	3 ±1	30 ±3
Pulsed mode 350 Hz	3 ±1	30 ±3

- Remove the test aerial from the unit to be tested.

4.8.2. Capacitor-field applicator

- Connect the resistance phantom circuit to X004/X005.
- Set the „Electrode-to-skin distance“ to 35 mm.
- Set the „Capacitor-field electrode, large“ applicator, CW mode and treatment time.
- Set „200 W“ by means of the power selector.
- After the tuning run, at least 8 LEDs of the bar indicator must be lit.

4.8.3. Auxiliary check of the power output

- Connect the corresponding applicator to the output of the unit.
- A box-type plastic or glass container (5 1 to 10 1) is to be filled with a 0.9-% salt solution.
- Position the applicator to the immediate vicinity of the container.
- After the tuning run, set the output power of the unit to „200“ W and change the position of the applicator so that as much as possible LEDs (7 to 10) of the bar indisator are lit.
- As additional control the assigned RF indicator can be used by positioning in front of or between the electrodes. In this case, the active surfaces of the capacitor-field electrodes are put together.

© gbo Medizintechnik AG 2004

4.9. Check of the internal error recognition circuits

4.9.1. Temperature monitoring circuit

- Set any mode of operation, applicator, treatment time and power at the unit to be tested.
- Short-circuit C008 (RF subassembly) to earth.
- The error condition „FEb“ has to be indicated at the „WATTS“ indicator and „0“ at the „MINUTES“ one.
- Eliminate the short-circuit and actuate the RESET key.

4.9.3. Generator voltage

- Switch off the unit, discharge C001.
- Short-circuit X204 to earth.
- Set the unit to the stand by mode.
- The error condition „FE7“ has to be indicated at the „WATTS“ indicator.
- Switch off the unit.
- Eliminate the short-circuit.

4.10. Continuous operation

4.10.1. Preparation for continuous operation

- Close the RF subassembly.
- Mount the face and, in doing so, observe that the earthing conductor is correctly connected.
- Connect the lamp phantom to output X004/X005.
- The continuous operation is to be performed with a room temperature between 35 °C and 40 °C.
- Record (time, type and duration) and eliminate all failures of the unit.

4.10.2. Performance of the continuous operation

- This test is to be performed in at least eight cycles of 30 min each in any pulsed and the CW mode of operation.
- Between the individual cycles the unit is to be separated from the mains for about 1 minute - install the unit, select the pulsed mode, „Capacitor-field, large“ applicator and a treatment time of „30“.
- The continuous operation starts with setting the maximum possible output power.
- After the termination of the treatment time separate the unit from the mains for about 1 min.
- Select the CW mode and the same settings as in the first cycle.

© gbo Medizintechnik AG 2004

- After the termination of treatment time separate the unit from the mains for about 1 min.

4.11. Final test

- The final test is to be performed immediately after the continuous operation in the hot condition.

4.11.1. High-voltage test

- The test is to be performed in accordance with DIN VDE 0750, Part 1, and DIN VDE 0750, Part 204.
- Connect the unit to be tested to the high-voltage testing device.
- Switch on („I“) mains switch S001.
- Apply the test voltage of 1.5 kV, 50 Hz, to the contact positions of the testing device for 1 min.
- In way of substitution, the test can also be performed with the pins of the power cord plug short-circuited and by applying the test voltage between this short-circuit jumper and the earthing contact of the power cord plug.
- The applicators are tested with a voltage of 4 kV.
- Record the test result.

4.11.2. Measurement of the leakage current of the casing

- The test is to be performed in accordance with DIN VDE 0750, Part 1, and DIN VDE 0750, Part 204.
- Connect the unit to be tested to the leakage-current measuring device.
- Switch on („I“) mains switch S001.
- Measure the leakage current of the casing at a rated voltage of 253 V. Record the maximum measurement value, $I_{leak/max}$ = 0.5 mA.
- Perform the measurement of the leakage current of the casing according to DIN 57 751/VDE 0751.

Record the measurement values.

4.11.3. Earthing conductor test

- The test is to be performed in accordance with DIN VDE 0750, Part 1, and DIN VDE 0750, Part 204.
- Connect the unit to be tested to the earthing-conductor testing device.

- Measure the voltage drops between the earthing conductor of the mains connector and all metal parts of the unit, that can be touched, under the following condition:
  I_{earth} = 10 A, $U_{earth/setpoint}$ < 2 V.
- Record the maximum measurement value.
- Perform the earthing conductor test according to DIN 57 751 or VDE 0751, respectively.
- Record the measurement values.

4.11.4. Measurement of the mains current consumption

- Measure the mains current consumption according to clause 4.6 and report the value.

4.11.5. Check of the power values

- Measure the power values according to clauses 4.8.1. and 4.8.2. and report the values.

4.11.6. Operation check

- Perform the operation check according to clause 4.4.

© gbo Medizintechnik AG 2004

5. Service instructions

5.1. Function check of the power generator A200

In case of troubles these instructions can be used for troubleshooting and for the determination of whether the power generator correctly operates or not. It shall be possible to localise the trouble up to the corresponding faulty subassembly.

ATTENTION: The setting components on the PCB (except R202 and R255) shall not be readjusted because special measuring instruments are required for the different setting values!

Measurement conditions: If not given elsewhere, all voltages given are to be measured against earth.

5.1.1. Check of the supply voltages

Check:
- +15 V (X206) and -15 V (X209) against earth.
- The secondary voltages of the mains transformer under no-load conditions, i. e. without any RF power output:
  about 45 V_{RMS} between X002.1 and X002.1
  about 26 V_{RMS} between X002.3 and X002.4.

5.1.2. Readiness for operation of the A200 subassembly

Separate the plug connection X207 and apply earth potential to the control-voltage input U_{in} (X207), i. e. RF power is not delivered.
Then measure the following voltages:

- **Power supply**

A voltage of about +13 V appears at X205. This voltage is superimposed by a serrated voltage of about 3 V and irregular period in the second range. At its pin 15 the integrated circuit N203 delivers an internally generated reference voltage of about -8.2 V measured against X205.

- **Voltage of the level control**

A voltage of about 0 V appears at the basis of V210, thus, the level control is blocked.

- **Analogous computer**

No voltage can be measured at the measurement points X214 to X218.

- **Cable voltage monitoring**

A voltage of about 14 V applies at the output of the operational amplifier N201/2, pin 7.

5.1.3. General information on the power loop

The power loop includes the following components:

5.1.3.1. Level control

The level control consists of: R242, V210, V211, L212, C223.
The range of the input voltage at the basis of V210 is about 0 to 12 V. With a voltage below approximately +2 V the level control delivers no output power. The level control is set to full amplification with a voltage of about 12 V to 14 V.

5.1.3.2. Amplification tract

This tract includes: R252, C235, L213, V212, C238, C239, L216, V213, L219, L220, C263, C264, L221, L222, L226, C273, C274, C275 to X219.

All stages operate in B-point mode without any zero-signal current. The following voltage values can be used as reference.
Voltage values to be determined by means of an oscilloscope:

The following list of levels is given for the elimination of errors, if required. It is valid for an output power of 250 W at 50 Ω (with the control voltage of +5 V at X207 and a DC voltage of +48 V at X205).

The values given are average ones.

- Voltage at the collector of V209 = 10 V_{pp} to 13 V_{pp} (V_{max} = 20 V, V_{min} = 7 V)
- Voltage at the basis of V211 = 4 V_{pp} to 5 V_{pp} (V_{max} = 2 V, V_{min} = -3 V)
- Voltage at the basis of V212 = 9 V_{pp} to 11 V_{pp} (V_{max} = 3 V, V_{min} = -7 V)
- Voltage at the collector of V212 = 17 V_{pp} to 20 V_{pp} (V_{max} = 23 V, V_{min} = 5 V)
- Voltage at the basis of V213 = 13 V_{pp} to 17 V_{pp} (V_{max} = 8 V, V_{min} = -6 V)
- Voltage at the collector of V213 = 100 V_{pp} to 115 V_{pp} (V_{max} = 115 V, V_{min} = 0 V)

© gbo Medizintechnik AG 2004

Typical measurement values of the correctly operating final stage:

DC operating voltage	U_b = +48 V at X205,
DC current consumption	I_b = 8.2 A to 8.7 A at X205,
Peak collector voltage	U_s = 110 V max.,
RMS value of the collector voltage	U_{RMS} = 35 V

5.1.3.3. Power and mismatching meter LFM

It includes: C201 to C205, L224, L225, R201 to R211, V203 and V204.

ATTENTION: Do not manipulate C202 and R201. R201 shall not be set to 0 Ω. An adjustment is only possible with an load resistor of accurately 50 Ω at X222 and a RF output power of about 200 W. Only under these conditions a mutual adjustment of C202 and R201 is possible for a minimum voltage at X218!

The reference voltages of the rectifiers V203 and V204 can be measured at eyelets X217 and X218. Their range of values is between 0 and -5 V. The voltage at X217 is always more negative than that at X218 or equal in the limit case.

The allocation is as follows:

- Correct matching at X222 (50 Ω)
  U at X218: <-10 mV at P = 0 to 250 W
  U at X217: 0 to -5 V according to the output power

- Medium mismatching at X222 (normally tuned condition)
  U at X218: 0 to -5 V according to the output power
  U at X217: 0 to -5 V according to the output power
  The voltage at X217 is always more negative than that at X218.

- Extreme mismatching at X222 (separated cable connection, etc.)
  U at X218: 0 to -5 V according to the output power
  U at X217: 0 to -5 V according to the output power
  Both voltages are equal in value!
  With 100 W output power about -3.5 V are applying at X217.

5.1.3.4. Adding amplifier

It includes: R213, R216, N201/4, R257 up to the plug connector X212.

The sum of the voltages measured at X217 and X218 can be determined at X212, however, the sign is changed.

© gbo Medizintechnik AG 2004

5.1.3.5. Subtracting amplifier

It includes: R212, R215, R214, N201/3, R256 up to the plug connector X211.

The difference of the voltages measured at X217 and X218 can be determined at X212, however, the sign is changed.

5.1.3.6. Multiplier (N202)

The variable resistors R203 to R205 shall not be readjusted. They are provided for offset tuning of the integrated circuit. At the output of the multiplier X216 a voltage U_0 must apply that can be determined as follows:

$$U_0 = \frac{(Voltage\ at\ X215) \bullet (Voltage\ at\ X214)}{10}$$

There shall be no voltage drop at the resistors R222 and R223. When after any integrated circuit replacement a new offset tuning is necessary perform as follows:

- 0 V at U_{in}
- Connect X214 and X215 to earth ⇒ set R205 to 0 V at X216.
- Apply +5 V at X215, connect X214 to earth ⇒ set R204 to 0 V at X216.
- Apply +5 V at X214, connect X215 to earth ⇒ set R203 to 0 V at X216.
- Repeat the adjustment one times more. A 4.5 V flat battery can also be used instead of the +5 V.

5.1.3.7. Setpoint/actual value comparator

It includes: R221, R225, R226, C210, V214, N201/1.

A voltage, that is exactly proportional to the active output power delivered, applies at X216 where 2.5 V correspond to an output power of 250 W. By means of an suitable power meter the adjustment is possible by R202.

In any case only one of the operational amplifiers N201/1 or N201/2 controls the voltage level. The output at which the lowest voltage applies, pin 1 or pin 7, controls the level. In the case pin 1 controls, that means at pin 7 there applies about +14 V, only half of the voltage applying at X207 can be measured at X208.

With a good matching to X222 normally voltages of about +3 V to +9 V can be measured at pin 1 of N201/1 but the value depends on the RF power.

© gbo Medizintechnik AG 2004

5.1.3.8. Cable voltage monitoring circuit

This circuit includes N201/2 and the externally connected components of which.

The sum voltage at X212 is a measure of the maximum RF voltage along the cable at X222. Integrated circuit N201/2 monitors this voltage. In the standard case, i. e. the load is matched to X222 and power requirement below 250 W, about +14 V apply at the output pin 7.

The cable voltage monitoring is active when extreme mismatching occurs at X222 and high RF power is required at the same time.

For checking, R219 can be bridged for a short time. This results in blocking the level control and, thus, the RF power becomes zero.

5.1.3.9. Analogous OR interconnection

It includes: V201, V202, R229.

Via R229 a current is fed into the basis of V210 trying to increase the level. When the RF voltage level is sufficient one of the control systems becomes active and takes over a component current through V201 or V202. In this way, the output power is stabilised. V201 and V202 are used to decouple the outputs of the operational amplifier.

5.1.4. Operation of the power supply

The power supply delivers the voltage at X205 which depends on the AC collector voltage of the final stage transistor. Tthis is obtained by feeding a current at pin 10 of N203 through V215/V216, R258. In case of matching the following relations apply:

Output power [W]	Voltage at X205 [V]
0	about 13
50	about 29
100	about 36
150	about 41
250	about 48

Be careful when working at the power supply. With full output power a direct short-circuit between X205 and earth can damage the integrated circuit N203!

© gbo Medizintechnik AG 2004

5.1.5. Oscillator

The oscillator operates at a voltage of 6.2 V measured across C219. The basis voltage of V208 is about 3.6 V. The RF wave should not be measured at V208 because the oscillations can be interrupted in case of loading; that's why, it is measured at V209. By means of L210 the voltage is tuned to the maximum of about 10 V_{pp} to 13 V_{pp} measured at the collector of V210. The core of L210 shall not be displaced without checking the oscillations by a RF oscilloscope because the oscillator operates only in a small tuning range of the core.

5.1.6. Driver

A voltage of 3.8 V measured across C233 ensures a sufficient zero-signal current of V209.

5.1.7. RF circuits at the final stage output

Spesial RF measuring instruments are required for matching the output circuits.

When the coils L226 or L227 are bend the resistors R250 and R251 can burn off. An auxiliary matching is possible by temporarily clamping two LEDs each, which are connected in anti-parallel to each other, in parallel to R250 and to R251. With small output powers these LEDs can be taken to the extinguished mode by slightly bending the coils L226 and L227. The coil 223 can only be adjusted by means of a spectrum analyser or wobbler. By slight bending it is adjusted to serial resonance with C265/C266 at 54.24 Mhz. In case of after-sales service work the coils L219 to L222 can only be checked for their geometry.

	L219	**L220**	**L221=222**
Inner diameter [mm]	10	10	10
Mounting height on the PCB [mm]	22	22	22
Distance between turns [mm]	3,5		
Length of the coil [mm]		8,5	8,5

5.1.8. Typical measurement values with a matched load (50 ohm)

U_{in} (X207)	= +2.0 V	The output power is 100 W
U at X216	= +1.0 V	
U at X217	= -3.5 V	
U at X218	= -0.2 V	
U at N201/3, pin 8	= +3.3 V	
U at N201/4, pin 14	= +3.7 V	
U at N201/1, pin 1	= +3.5 V	
U at N201/2, pin 7	= +14.3 V	
U at the basis of V210	= 3.1 V	

© gbo Medizintechnik AG 2004

5.2. Repair instructions for the control computer (A400)

5.2.1. Indication of the error conditions

The control computer subassembly performs a series of internal monitoring operations which, in case of an error, release the following error messages.

Indisation	Cause of error
FE0	Operation error; the power selector has been actuated without any setting of operation parameters in advance.
FE1	At the time of putting the unit into operation a key (S401 to S408, S410 to S412) is short-circuited. The encoded key designation appears an the „MINUTES“ indicator; there is the following allocation: 1 - S401 („-“) 2 - S408 (small coil field applicator) 3 - S402 (350 Hz pulsed mode) 4 - S407 (medium coil-field applicator) 5 - S410 (large cap.-field applicator) 6 - S403 (70 Hz pulsed mode) 7 - S406 (**DIPLODE**) 8 - S411 (medium cap.-field appl.) 9 - S404 (CW operation) A - S405 („+“) b - S412 (small cap.-field appl.)
FE2	An output power is measured though the power selector is on „zero“.
FE3	The power measured after the matching operation (indication „A’) exceeds the permissible limit value.
FE4	In pulsed operation an inadmissible high power has been measured during the pulse interval.
FE5	The voltage applying at C402 cannot be adjusted to the setpoint (operating voltages of + 15 V are not correct, network N401A or pulse generator D408 is defective).
FE6	With any power selection the output power measured is „zero“.
FE7	The supply voltage at X002.3 is inadmissible high; the triggering of thyristor V001 is disturbed.
FE8	The power of the lowest range cannot be adjusted in the corresponding mode.
FE9	The thermistor circuit (R003) is interrupted.
Feb	Thermal overloading of the power generator or short-circuit of R003, respectively. In the first case, wait only for cooling down in the stand by mode, in the second one the unit is defective; this defect can be recognized by the indication „0“ at the treatment time indicator.
FEC	Shows a Reset actuation by integrated circuit D401. An error message can only be indicated within the framework of the operation of microprocessor D402.

© gbo Medizintechnik AG 2004

5.2.2. Description of the control computer signals

The following typical voltages can be measured to earth:

D401.11 (WDI)	5 V CMOS pulses (low-active), duration about 0.8 ms, period 4.0 ms to 4.8 ms
D401.14 (WDO)	TTL, high
D401.15 (RES)	TTL, high
D401.1 (VCC)	5 V (V_{pp} at pin 68)
D402.65 (CLKOUT)	5 V CMOS, balanced clock of about 4 Mhz.
D402.39 (P2.5/PWM)	5 V CMOS pulses (high-active), period about 122 µs, pulse duration about 20 µs in the stand by mode, pulse duration about 92 µs in 30 W pulsed mode, pulse duration about 90 µs in 200 W CW mode.
C402	DC voltage between 0.5 V and 4 V depending on the duty factor at D402.39, superimposed by a serrated voltage (U_{pp} < 50 mV).
D402.45 (P4.7/AD15)	5 V CMOS Stand by mode • high level „70 Hz“ pulsed mode, 30 W • pulses (low-active), duration about 2 ms, period about 14 ms; „350 Hz“ pulsed mode, 30 W • pulses (low-active), duration about 410 µs, period about 2.8 ms; CW mode, 200 W • low level.
N401B.9	Stand by mode. • about -0.5 V „70 Hz“ pulsed mode, 30 W • pulses (high-active), duration about 2 ms, period about 14 ms; high level about 4.2 V low level about -0.5 V „350 Hz“ pulsed mode, 30 W • pulses (high-active), duration about 410 µs, period about 2.8 ms; high level about 4.2 V low level about-0.5 V CW mode, 200 W • about 4.0 V.
D408.2/D408.4	When the pulse transmitter is not actuated both terminals are on TTL-low level. During the turning both terminals deliver time-delayed high-level pulses the phase of which is given by the direction of rotation.
D402.11(P0.4)	About 0.8 V in stand by mode; about 2.9 V at an output power of 200 W (50 Ω at X004/X005).
D402.4 (P0.3)	About 2.5 V at a temperature of the heat sink (A200) of 25 °C, the voltage decreases with increasing temperature.
R445	5 V, in case of emergency-off switch actuation 0.6 V.
R444	1.2 V, in case of emergency-off switch actuation 5 V.
T407/emitter	0 V, in case of emergency-off switch actuation -15 V, relay K001 must switch over.

The other signals of the analogous inputs (port 0) of D402 are given in the Overall Circuit Diagram. At the pins of ports 1 to 4, which are not described, there apply signals the parameter of which are changed during the program running time; in general they are pulse-shaped.

5.3. Power supply (A100)

At the A100 subassembly only the output voltages are checked in the stand by and power modes. In case of a negative result check and, if required, replace the mains fuse element of this subassembly. If this does not eliminate the trouble replace the subassembly.

WARNING: There are several accessible components on mains potential!

ATTENTION: The earthing conductor is screwed on and, thus, the contact is not necessarily ensured!

5.4. Output circuit (A300)

With this subassembly, take particular care for correct soldered connections and tightened screw connections, otherwise, due to the heavy RF currents partial thermal overloading can occur.

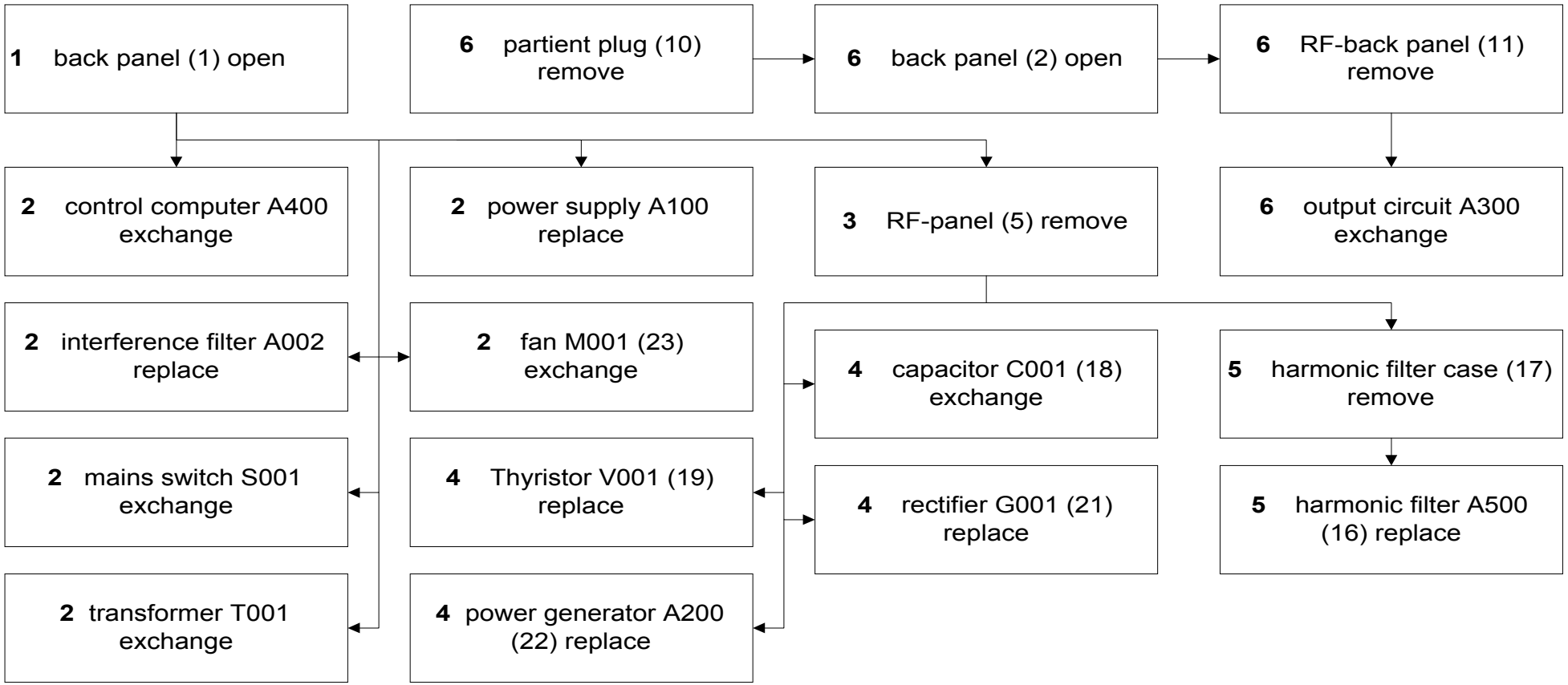
5.5. Harmonic filter (A500)

Take particular care for correct soldered connections. In case of voltage arcovers or burning replace the subassembly by an intact, adjusted one. In any case, do not replace components of this subassembly because this would negatively affect the adjustment which can only be performed by the manufacturer.

© gbo Medizintechnik AG 2004

6. Disassembly/assembly flow chart

(look also picture 1 and 2)


1 back panel (1) open
6 partient plug (10) remove
6 back panel (2) open
6 RF-back panel (11) remove
2 control computer A400 exchange
2 power supply A100 replace
3 RF-panel (5) remove
6 output circuit A300 exchange
2 interference filter A002 replace
2 fan M001 (23) exchange
4 capacitor C001 (18) exchange
5 harmonic filter case (17) remove
2 mains switch S001 exchange
4 Thyristor V001 (19) replace
4 rectifier G001 (21) replace
5 harmonic filter A500 (16) replace
2 transformer T001 exchange
4 power generator A200 (22) replace

© gbo Medizintechnik AG 2004

7. Ordering Information

Accessories:	article number:
Capacitor-field set, consisting of:	
2 Schliephake spacer electrodes with calibration pin	
a) Plate diameter 42 mm, outer diameter 85 mm	23-58-984 Q 4547
b) Plate diameter 85 mm, outer diameter 130 mm	23-58-976 Q 4547
c) Plate diameter 130 mm, outer diameter 172 mm	23-58-968 Q 4547
d) Plate diameter 172 mm, outer diameter 220 mm	23-58-950 Q 4547
2 Support arms per choice	see other accessory
(2 x regular arms or flexible arm, left and right)	
2 Applicator-connection cables 120 cm without lead protection	19-05-215 Q 4824
2 Cable holder (for cable without lead protection)	23-38-499 Q 5028
1 Cable clamp, small (for cable without lead protection)	23-51-245 Q 4562
or	
2 Applicator-connection cables 120 cm with lead protection	19-89-870 Q 4824
1 Cable clampe , big (for cable with lead protection)	19-53-363 Q 4514
Plate-Applicator set 1, consisting of:	
2 Soft-rubber plate applicators	19-53-413 Q 3236
8 cm x 14 cm with cable and plug	
4 Felt spacer, 9 cm x 16 cm	19-53-272 Q 3236
2 Cloth coatings	23-95-606 Q 3236
2 Rubber bands 42 cm	45-38-971 EH 725
4 Fastening buttons	22-74-801 Q 1320
Plate-Applicator set 2, consisting of:	
2 Soft-rubber plate applicators	19-53-421 Q 3236
12 cm x 18 cm with cable and plug	
4 Felt spacer, 13 cm x 20 cm	19-53-280 Q 3236
2 Cloth coatings	23-95-614 Q 3236
2 Rubber bands, 42 cm	45-38-971 EH 725
4 Fastening buttons	22-74-801 Q 1320
Plate-Applicator set 3, consisting of:	
2 Soft-rubber plate applicators	19-53-439 Q 3236
18 cm x 27 cm with cable and plug	
4 Felt spacer, 19 cm x 29 cm	19-53-298 Q 3236
2 Cloth coating	23-95-622 Q 3236
2 Rubber bands, 135 cm	45-38-963 EH 725
4 Fastening buttons	22-74-801 Q 1320

© gbo Medizintechnik AG 2004

Coil applicator

(needs one (1) support arm)

MINODE with cable	23-50-114 Q 4558
MONODE with cable	23-47-573 Q 4544
DIPLODE with cable	42-26-809 Q 4562

Other accessory:

Applicator-connection cable, without lead protection Length 120 cm	19-05-215 Q 4824
Applicator-connection cable, with lead protection Length 120 cm	19-89-870 Q 4824
Arm, regular	011-1-0156
Flex arm, on the left	011-1-0169
Flex arm, on the right	011-1-0170
Cable holder (for cable without lead protection)	23-38-499 Q 5028
Clamp, small (for cable without lead protection)	23-51-245 Q 4562
Clamp, big (for cable with lead protection)	19-53-363 Q 4514
Indicator discharge tube	22-53-722 Q 3215
User Manual for the **ULTRATHERM 908i** in English	011-7-0324
User Manual for the **ULTRATHERM 908i** in German	011-7-0323

© gbo Medizintechnik AG 2004

8. Parts list

Part:	Denotation:	Articel number:
RF-connector	X002	
Output curcuit	A300	
DC fan	M001	
Plug D16		
Control knob for the dosage		
Adjustable capaciter with stepping motor	C302	
Plug	C016 bis C019	
Interference protection filter 6-ESK-1	A002	
EMI-filter	C002/C003	
Front foil		
Mains cable 3x0,75		011-4-5011
Rectifier B80/70-50	G001	
Thermistor	R003	
Stepping motor	M301	
Capacitor 10000µF/63V	C001	
Capacitor FC	C004-007 u. C009-C015	
Power generator	A200	
Power relay	K001	
Castor		008-1-0099
Castor with brake		008-1-0100
Precision resistor 50 ohm		
Mains input, fuse holder (230 V)	A001	007-4-5010
Mains input, connector	A001	007-4-5011
Mains switch (230 V)	S001	007-2-2003
Mains switch (115 V)	S001	007-2-2004
Transformer (230/115 V)	T001	
Emergency-off switch	S002	
Emergency-off, pullcord		
Emergency-off, pullcord ball		
O-ring 86x3, oil resistent (for M301-C302)		
Harmonic filter	A500	
Patient plug	X004/X005	
Control computer	A400	
Power supply	A100	
Thyristor	V001	

© gbo Medizintechnik AG 2004

9. Wiring diagramms

Picture	Denotation:	Article number:	Version A
1	Explosion diagramm **ULTRATHERM 908i**		1
2	HF-part **ULTRATHERM 908i**		1
3	Overall Wiring Diagramm **ULTRATHERM 908i**		1
4 a. 5	**A200** power generator		1
6	**A400** control computer		1
7	Layout A200 power generator		1
8	Layout A300 output circuit		1
9	Layout A400 control computer (controle side)		1
10	Layout A400 control computer (component side)		1
11	Layout A500 harmonic filter		1

© gbo Medizintechnik AG 2004

Correction sheet

gbo Medizintechnik AG
- Dokumentation -
Kleiststr. 6

D-64668 Rimbach
Germany

Please revise the following errors and stimulation to the document:

page	**line**	**wrong text**	**right text**

Address:

Artikel-Nr. 001-9-0086

© gbo Medizintechnik AG 2004